



Technical Review Workgroup for Lead (TRW)



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[Who Are We?](#)[The IEUBK](#)[IEUBK FAQs](#)[Adult Lead Model](#)[Risk Assessment](#)[Hotline](#)[Products](#)[Workshops](#)[Lead in Human Health](#)[Related Sites](#)

The IEUBK

- [Download IEUBKwin version 1.0](#)
- [Introduction](#)
- [Model Overview](#)
- [Simulation](#)
- [Use of the IEUBK model for Pb Risk Assessment](#)
- [Frequently Asked Questions](#)



Introduction

[\[Back To Top\]](#)

Lead (Pb) poisoning presents potentially significant risks to the health and welfare of children all over the world today. The Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) attempts to predict blood-lead concentrations (PbBs) for children exposed to Pb in their environment. The model allows the user to input relevant absorption parameters, (e.g., the fraction of Pb absorbed from water) as well as rates for intake and exposure. Using these inputs, the IEUBK model then rapidly calculates and recalculates a complex set of equations to estimate the potential concentration of Pb in the blood for a hypothetical child or population of children (6 months to 7 years). Measured PbB concentration is not only an indication of exposure, but is a widely used index to discern future health problems.

EPA and the Centers for Disease Control and Prevention (CDC) have determined that childhood PbB concentrations at or above 10 micrograms of Pb per deciliter of blood ($\mu\text{gPb/dL}$) present risks to children's health. Accordingly, EPA management actions seek to limit the risk that children will have Pb concentrations above 10 $\mu\text{gPb/dL}$ and the Agency conducts risk assessments that reduce the likelihood that such exposures would occur. The IEUBK model calculates the probability that children's PbB concentrations will exceed 10 $\mu\text{gPb/dL}$ (or other user-entered value). By varying the data entered into the model, the user can evaluate how changes in environmental conditions may affect PbB levels in exposed children.

Model Overview

[\[Back To Top\]](#)

The IEUBK model is designed to predict the probable PbB concentrations for children between six months and seven years of age who have been exposed to Pb through environmental media (air, water, soil, dust, and diet). The model has the following four functional components:

- [Exposure Component](#): compares Pb concentrations in

environmental media with the amount of Pb entering a child's body. The exposure component uses environmental media-specific consumption rates and Pb concentrations to estimate media-specific Pb intake rates.

- **Uptake Component:** compares Pb intake into the lungs or digestive tract with the amount of Pb absorbed into the child's blood.
- **Biokinetic Component:** shows the transfer of Pb between blood and other body tissues, or the elimination of Pb from the body altogether.
- **Probability Distribution Component:** shows a probability of a certain outcome (e.g., a PbB concentration greater than 10 µgPb/dL in an exposed child based on the parameters used in the model).

Simulation

[\[Back To Top\]](#)

The IEUBK model standardizes exposure by assuming age-weighted parameters for intake of food, water, soil, and dust. The model simulates continual growth under constant exposure levels (on a year-to-year basis). In addition, the model also simulates Pb uptake, distribution within the body, and elimination from the body.

It is commonly thought that the IEUBK model can predict the average PbB level for an entire community. This is misleading, since many factors may vary between different homes within a single community. Instead of using community means for the environmental Pb inputs, it would be more accurate to first apply the IEUBK model to individual homes or homogeneous areas, then combine the results in order to find the mean for a neighborhood or community.

Use of the IEUBK model for Pb Risk Assessment

[\[Back To Top\]](#)

The IEUBK model is intended to:

- Estimate a typical child's long-term exposure to Pb in and around his/her residence;
- Provide an accurate estimate of the geometric average PbB concentration for a typical child aged six months to seven years;
- Provide a basis for estimating the risk of elevated PbB concentration for a hypothetical child;
- Predict likely changes in the risk of elevated PbB concentration from exposure to soil, dust, water, or air following concerted action to reduce such exposure;
- Provide assistance in determining target cleanup levels at specific residential sites for soil or dust containing high amounts of Pb;
- Provide assistance in estimating PbB levels associated with the Pb concentration of soil or dust at undeveloped sites which may be developed at a later date.

A site-specific risk assessment requires information on soil and dust Pb concentrations for the particular site in question. Variables affecting any consideration of Pb exposure from soil and dust include: soil to indoor dust transfer; ingestion parameters for soil and dust (*i.e.*, how much soil or dust a typical child may ingest or inhale over a set period of time); and the amount of Pb that can be absorbed from the soil. These parameters are quite sensitive -- that is, changing one variable can significantly affect the results.

The IEUBK model is designed to facilitate calculating the risk of elevated PbB levels, and is helpful in demonstrating how results may change when the user enters different parameters. Overall, the IEUBK model is a tool to assess PbB concentrations in children exposed to Pb. Its greatest advantage to the user is that it takes into consideration the several different media through which children can be exposed.

Source: Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (February 1994) [NTIS #PB93-963510, OSWER #9285.7-15-1]

[[Back to Top](#)]

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URL: <http://www.epa.gov/superfund/programs/lead/ieubk.htm>

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